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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/573,331	OKAMURA ET AL.	
	Examiner	Art Unit	
	Derek J. Rosenau	2834	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 February 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *33-64* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *33-52,58,59 and 61-64* is/are rejected.

7)☒ Claim(s) *53-57 and 60* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 March 2006* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3/23/06 2/2/07 4/4/08*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement filed 2/2/2007 fails to comply with 37 CFR 1.98(a)(3) because it does not include a concise explanation of the relevance, as it is presently understood by the individual designated in 37 CFR 1.56(c) most knowledgeable about the content of the information, of each patent listed that is not in the English language. It has been placed in the application file, but the information referred to therein has not been considered.

Drawings

2. Figures 8A, 8B, and 9 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 15, 51, 52, 53, 55, 61, and 70. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply

to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

5. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

6. The disclosure is objected to because of the following informalities. On pages 2 and 3, the prior art drawings are described using reference numbers for the present invention. For example, on page 2, it appears that "piezoelectric layers 1 and internal electrodes 2" should be "piezoelectric layers 11 and internal electrodes 12". Similarly, on page 3, it appears that "internal electrodes 2 are connected to external electrode 4" should be "internal electrodes 12 are connected to external electrodes 15".

Appropriate correction is required.

7. The disclosure is objected to because of the following informalities: on page 5, it appears that "mount" should be "amount".

Appropriate correction is required.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 38 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 38 compares the values of the resistance and conductivity of the internal electrodes. These properties do not have equivalent units, and therefore cannot be compared in the fashion claimed. For purposes of examination, it will be assumed that "wherein a resistance of the internal electrode is lower than" is meant to be wherein a conductivity of the internal electrode is lower than".

10. Claim 56 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant

regards as the invention. It is unclear what is meant by "wherein the glass component contained in the external electrode exists in a region substantially not more than 80% in thickness of the external electrode on the side of the surface of the stack".

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

12. Claims 33-35, 37, 38, and 42-45 are rejected under 35 U.S.C. 102(b) as being anticipated by Murai et al. (US 2003/0080651).

13. With respect to claim 33, Murai et al. discloses a multi-layer piezoelectric element (Figs 2a and 2b) comprising a stack formed by stacking piezoelectric layers (item 11) and internal electrodes (items 21 and 22) alternately one on another and external electrodes (items 31 and 32) formed on a first side face and on a second side face of the stack (Fig 2b), one of the adjacent internal electrodes being connected to the external electrode formed on the first side face and the other internal electrode being connected to the external electrode formed on the second side face (Fig 2b), wherein the metal composition contained in the internal electrodes contains group VIII metal and group Ib metal of the periodic table as the main components (Paragraph 22), and elements of the group VIII metal and the group Ib metal are set so that proportion M1 (% by weight) of the group VIII metal and proportion M2 (% by weight) of the group Ib

metal satisfy the relations $0 < M1 \leq 15$, $85 \leq M2 < 100$ and $M1 + M2 = 100$ (Paragraph 22).

14. With respect to claim 34, Murai et al. discloses the multi-layer piezoelectric element according to claim 33; wherein the group VIII metal is at least one kind selected from a group consisting of Ni, Pt, Pd, Rh, Ir, Ru, And Os (Paragraph 22), and the Ib metal is at least one kind selected from a group consisting of Cu, Ag, and Au (Paragraph 22).

15. With respect to claim 35, Murai et al. discloses the multi-layer piezoelectric element according to claim 34; wherein the group VII metal is at least one kind selected from a group consisting of Pt and Pd, and the Ib metal is at least one kind selected from a group consisting of Ag and Au (Paragraph 22),

16. With respect to claim 37, Murai et al. discloses a multi-layer piezoelectric element (Figs 2a and 2b) comprising a stack formed by stacking piezoelectric layers (item 11) and internal electrodes (items 21 and 22) alternately one on another and external electrodes (items 31 and 32) formed on a first side face and on a second side face of the stack (Fig 2b), one of the adjacent internal electrodes being connected to the external electrode formed on the first side face and the other internal electrode being connected to the external electrode formed on the second side face (Fig 2b), wherein a resistance of the internal electrode is higher than a resistance pAg of the device having the internal electrode of which metallic component consists solely of silver, and is lower than the resistance pPd of the device having the internal electrode of which metallic component consists solely of palladium (Paragraph 22). The language “wherein a

resistance of the internal electrode is higher than a resistance pAg of the device having the internal electrode of which metallic component consists solely of silver, and is lower than the resistance pPd of the device having the internal electrode of which metallic component consists solely of palladium" is simply a recitation of a material property. As Murai et al. discloses the claimed electrode material, its electrical resistance would be in the claimed range. Murai et al. discloses an electrode material that is a combination of Ag and Pd; therefore, the resistivity of the Ag/Pd electrode would be between the resistivities of Ag and Pd.

17. With respect to claim 38, Murai et al. discloses the multi-layer piezoelectric element according to claim 33, wherein a conductivity of the internal electrode is lower than a conductivity oAg of the device having the internal electrode of which metallic component consists solely of silver, and is higher than the conductivity oPd of the device having the internal electrode of which metallic component consists solely of palladium (Paragraph 22). As with claim 37, this is simply a recitation of an inherent material property. As Murai et al. discloses the claimed electrode material, its electrical conductivity would be in the claimed range. Murai et al. discloses an electrode material that is a combination of Ag and Pd; therefore, the conductivity of the Ag/Pd electrode would be between the conductivities of Ag and Pd.

18. With respect to claim 42, Murai et al. discloses the multi-layer piezoelectric element according to claim 33, wherein the piezoelectric material contains perovskite type oxide as the main component (Paragraph 24).

19. With respect to claim 43, Murai et al. discloses the multi-layer piezoelectric element according to claim 42, wherein the piezoelectric material contains perovskite type oxide consisting of $PbZrO_3$-$PbTiO_3$ as the main component (Paragraph 24).

20. With respect to claim 44, Murai et al. discloses the multi-layer piezoelectric element according to claim 33, wherein the temperature of firing the stack is in a range from 900 to 1000 degrees Celsius (Paragraph 201). In addition, this is a product-by-process claim. It has been held that if a product in a product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even if the prior product was made by a different process (*In re Thorpe*, 227 USPQ 964).

21. With respect to claim 45, Murai et al. discloses the multi-layer piezoelectric element according to claim 33, wherein the deviation in the composition of the internal electrode that is caused by the firing operation is 5% or less (Paragraph 22). This is a product-by-process claim, and it has been held that if a product in a product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even if the prior product was made by a different process (*In re Thorpe*, 227 USPQ 964). In addition, the claim language describes the device at an intermediate step in production. In an apparatus claim, it is the final product that matters.

22. Claims 33-35, 37, 38, and 40-45 are rejected under 35 U.S.C. 102(b) as being anticipated by Hammer et al. (US 2001/0054859).

23. With respect to claim 33, Hammer et al. discloses a multi-layer piezoelectric element (Fig 1) comprising a stack formed by stacking piezoelectric layers (item 12) and internal electrodes (items 13 and 14) alternately one on another and external electrodes

(items 10 and 11) formed on a first side face and on a second side face of the stack (Fig 1), one of the adjacent internal electrodes being connected to the external electrode formed on the first side face and the other internal electrode being connected to the external electrode formed on the second side face (Fig 1), wherein the metal composition contained in the internal electrodes contains group VIII metal and group Ib metal of the periodic table as the main components (Paragraph 22), and elements of the group VIII metal and the group Ib metal are set so that proportion M1 (% by weight) of the group VIII metal and proportion M2 (% by weight) of the group Ib metal satisfy the relations $0 < M1 \leq 15$, $85 \leq M2 < 100$ and $M1 + M2 = 100$ (Paragraph 22).

24. With respect to claim 34, Hammer et al. discloses the multi-layer piezoelectric element according to claim 33; wherein the group VIII metal is at least one kind selected from a group consisting of Ni, Pt, Pd, Rh, Ir, Ru, And Os (Paragraph 22), and the Ib metal is at least one kind selected from a group consisting of Cu, Ag, and Au (Paragraph 22).

25. With respect to claim 35, Hammer et al. discloses the multi-layer piezoelectric element according to claim 34; wherein the group VII metal is at least one kind selected from a group consisting of Pt and Pd, and the Ib metal is at least one kind selected from a group consisting of Ag and Au (Paragraph 22),

26. With respect to claim 37, Hammer et al. discloses a multi-layer piezoelectric element (Fig 1) comprising a stack formed by stacking piezoelectric layers (item 12) and internal electrodes (items 13 and 14) alternately one on another and external electrodes (items 10 and 11) formed on a first side face and on a second side face of the stack (Fig

1), one of the adjacent internal electrodes being connected to the external electrode formed on the first side face and the other internal electrode being connected to the external electrode formed on the second side face (Fig 1), wherein a resistance of the internal electrode is higher than a resistance pAg of the device having the internal electrode of which metallic component consists solely of silver, and is lower than the resistance pPd of the device having the internal electrode of which metallic component consists solely of palladium (Paragraph 22). The language "wherein a resistance of the internal electrode is higher than a resistance pAg of the device having the internal electrode of which metallic component consists solely of silver, and is lower than the resistance pPd of the device having the internal electrode of which metallic component consists solely of palladium" is simply a recitation of a material property. As Hammer et al. discloses the claimed electrode material, its electrical resistance would be in the claimed range. Hammer et al. discloses an electrode material that is a combination of Ag and Pd; therefore, the resistivity of the Ag/Pd electrode would be between the resistivities of Ag and Pd.

27. With respect to claim 38, Hammer et al. discloses the multi-layer piezoelectric element according to claim 33, wherein a conductivity of the internal electrode is lower than a conductivity oAg of the device having the internal electrode of which metallic component consists solely of silver, and is higher than the conductivity oPd of the device having the internal electrode of which metallic component consists solely of palladium (Paragraph 22). As with claim 37, this is simply a recitation of an inherent material property. As Hammer et al. discloses the claimed electrode material, its

electrical conductivity would be in the claimed range. Hammer et al. discloses an electrode material that is a combination of Ag and Pd; therefore, the conductivity of the Ag/Pd electrode would be between the conductivities of Ag and Pd.

28. With respect to claim 40, Hammer et al. discloses the multi-layer piezoelectric element according to claim 33; wherein an inorganic component is contained along with the metallic component in the internal electrode (Paragraphs 20-22).

29. With respect to claim 41, Hammer et al. discloses the multi-layer piezoelectric element according to claim 40; wherein the inorganic component contains perovskite type oxide consisting of $PbZrO_3$-$PbTiO_3$ as the main component (Paragraphs 20-22).

30. With respect to claim 42, Hammer et al. discloses the multi-layer piezoelectric element according to claim 33, wherein the piezoelectric material contains perovskite type oxide as the main component (Paragraph 17).

31. With respect to claim 43, Hammer et al. discloses the multi-layer piezoelectric element according to claim 42, wherein the piezoelectric material contains perovskite type oxide consisting of $PbZrO_3$-$PbTiO_3$ as the main component (Paragraph 17).

32. With respect to claim 44, Hammer et al. discloses the multi-layer piezoelectric element according to claim 33. The language "wherein the temperature of firing the stack is in a range from 900 to 1000 degrees Celsius" is a product-by-process limitation. It has been held that if a product in a product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even if the prior product was made by a different process (*In re Thorpe*, 227 USPQ 964).

33. With respect to claim 45, Hammer et al. discloses the multi-layer piezoelectric element according to claim 33, wherein the deviation in the composition of the internal electrode that is caused by the firing operation is 5% or less (Paragraph 22). This is a product-by-process claim, and it has been held that if a product in a product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even if the prior product was made by a different process (*In re Thorpe*, 227 USPQ 964). In addition, the claim language describes the device at an intermediate step in production. In an apparatus claim, it is the final product that matters.

Claim Rejections - 35 USC § 103

34. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

35. Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al.

36. With respect to claim 39, Murai et al. discloses the multi-layer piezoelectric element according to claim 33, wherein 80% by volume or more of crystal grains formed from the metallic component that constitutes the internal electrode have particle size of 1 micrometer or larger (Paragraph 23). While Murai et al. does not disclose explicitly that 80% or more of the crystal grains are 1 micrometer or larger, Murai et al. does disclose that 80% of the particles are 10 micrometers or smaller. Therefore, it would be obvious to a person of ordinary skill in the art to form the device of Murai et al. with

particle sizes that are at the large end of the range disclosed, resulting in 80% by volume or more of the crystal grains having a particle size of 1 micrometer or more.

37. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al. or Hammer et al. in view of Yoshii et al. (US 2001/0043454).

38. With respect to claim 36, both Murai et al. and Hammer et al. disclose the multi-layer piezoelectric element according to claim 34.

Neither Murai et al. nor Hammer et al. disclose expressly that the group Ib metal is Cu.

Yoshii et al. teaches a multi-layer piezoelectric device in which the group Ib metal is Cu (Paragraphs 47 and 53).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to replace the Ag-Pd alloy of Murai et al. with the Cu-Pd alloy of Yoshii et al. for the benefit of using a less expensive base metal for the alloy.

39. Claims 46, 47, 50-52, and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al. or Hammer et al. in view of Kawazoe (US 2002/0084872).

40. With respect to claim 46, both Murai et al. and Hammer et al. disclose the multi-layer piezoelectric element according to claim 35.

Neither Murai et al. nor Hammer et al. disclose expressly that the external electrode is formed from an electrically conductive material consisting mainly of silver and glass, or that proportions of silver contained in the internal electrode and the external electrode are set so that the proportion X (%by weight) of silver contained in

the electrically conductive material as a whole and the proportion Y (% by weight) of silver to the total weight of the electrically conductive material and glass contained in the external electrode satisfy the conditions of $X \geq 85$ and $0.9 \leq X/Y \leq 1.1$.

Kawazoe teaches a multi-layer piezoelectric device in which the external electrode is formed from an electrically conductive material consisting mainly of silver and glass (Paragraph 47), and in which the proportions of silver contained in the internal electrode and the external electrode are set so that the proportion X (%by weight) of silver contained in the electrically conductive material as a whole and the proportion Y (% by weight) of silver to the total weight of the electrically conductive material and glass contained in the external electrode satisfy the conditions of $X \geq 85$ and $0.9 \leq X/Y \leq 1.1$ (Paragraph 47).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the silver/glass external electrodes of Kawazoe with the multi-layer piezoelectric device of either Murai et al. or Hammer et al. for the benefit of preventing poor connection between the internal and external electrodes.

41. With respect to claim 47, the combination of Murai et al. or Hammer et al. and Kawazoe discloses the multi-layer piezoelectric element according to claim 46. Hammer et al. discloses that the internal electrode contains piezoelectric material (Paragraph 20) and that the proportion X (% by weight) of silver to the total weight of the internal electrode containing the piezoelectric material satisfies the condition of $0.7 \leq Z/Y \leq 1.0$ (Paragraph 22).

42. With respect to claim 50, the combination of Murai et al. or Hammer et al. and Kawazoe discloses the multi-layer piezoelectric element according to claim 46. Hammer et al. discloses that the softening point of the glass used in the external electrode is not higher than 4/5 of the melting point of the electrically conductive material that constitutes the internal electrode. The softening point of the glass and melting point of the conductive material are simply inherent material properties of the glass and conductive material. As the glass in the external electrode and the conductive material of the internal electrode in the device of Hammer et al. are the same as the claimed materials, the material properties of those materials would inherently be the same.

43. With respect to claim 51, the combination of Murai et al. or Hammer et al. and Kawazoe discloses the multi-layer piezoelectric element according to claim 50. Hammer et al. discloses that the glass that constitutes the external electrode is amorphous, as glass is an amorphous material.

44. With respect to claim 52, the combination of Murai et al. or Hammer et al. and Kawazoe discloses the multi-layer piezoelectric element according to claim 46. Murai et al., Hammer et al., and Kawazoe et al. disclose that a thickness of the external electrode is smaller than a thickness of the piezoelectric layer that constitutes the stack (Fig 2b of Murai et al., Fig 1 of Hammer et al., and Fig 1B of Kawazoe).

45. With respect to claim 59, both Murai et al. and Hammer et al. disclose the multi-layer piezoelectric element according to claim 33.

Neither Murai et al. nor Hammer et al. discloses that a glass-rich layer is formed on the surface of the external electrode on the side thereof facing the piezoelectric layer.

Kawazoe teaches a multi-layer piezoelectric device that includes a glass-rich layer is formed on the surface of the external electrode on the side thereof facing the piezoelectric layer (Paragraph 47).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the glass-rich layer of Kawazoe with the multi-layer piezoelectric device of either Murai et al. or Hammer et al. for the benefit of preventing poor connection between the internal and external electrodes.

46. Claims 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al. or Hammer et al. in view of Kawazoe and Bindig et al. (US 6208026).

47. With respect to claim 48, the combination of Murai et al. or Hammer et al. and Kawazoe discloses the multi-layer piezoelectric element according to claim 46.

None of Murai et al., Hammer et al., or Kawazoe discloses expressly that the external electrode is formed from a porous electrically conductive material that has 3-dimensional mesh structure.

Bindig et al. teaches a multi-layer piezoelectric device in which the external electrode is formed from a porous electrically conductive material that has 3-dimensional mesh structure (Figs 4 and 5).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the porous external electrode with the multi-layer piezoelectric

device of Murai et al. or Hammer et al. as modified by Kawazoe, for the benefit of allowing the external electrode to be expandable between contact points (column 2, lines 1-25 of Bindig et al.).

48. With respect to claim 49, the combination of Murai et al. or Hammer et al. and Kawazoe discloses the multi-layer piezoelectric element according to claim 46.

None of Murai et al., Hammer et al., or Kawazoe discloses that a void ratio of the external electrode is in a range from 30 to 70% by volume.

Bindig et al. teaches a multi-layer piezoelectric device in which a void ratio of the external electrode is in a range from 30 to 70% by volume (Fig 5).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the porous external electrode with the multi-layer piezoelectric device of Murai et al. or Hammer et al. as modified by Kawazoe, for the benefit of allowing the external electrode to be expandable between contact points (column 2, lines 1-25 of Bindig et al.).

49. Claims 58, 62, and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al. or Hammer et al. in view of Nakamura et al. (US 2002/0158552).

50. With respect to claim 58, both Murai et al. and Hammer et al. disclose the multi-layer piezoelectric element according to claim 33.

Neither Murai et al. nor Hammer et al. discloses that the electrically conductive material of the internal electrode diffuses into the external electrode so as to form a neck in the joint between the internal electrode and the external electrode.

Nakamura et al. teaches a multi-layer piezoelectric device in which the electrically conductive material of the internal electrode diffuses into the external electrode so as to form a neck in the joint between the internal electrode and the external electrode (Figs 2a-2c and Paragraph 19).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the neck portion of Nakamura et al. with the multi-layer piezoelectric device of Murai et al. or Hammer et al. for the benefit of more firmly securing the external and internal electrodes together (Paragraph 19 of Nakamura et al.).

51. With respect to claim 62, both Murai et al. and Hammer et al. disclose the multi-layer piezoelectric element according to claim 33.

Neither Murai et al. nor Hammer et al. discloses expressly an electrically conductive assisting member formed from an electrically conductive adhesive, containing a metal mesh or a mesh-like metal sheet embedded therein, on the external surface of the external electrode.

Nakamura et al. teaches a multi-layer piezoelectric device including an electrically conductive assisting member formed from an electrically conductive adhesive, containing a metal mesh or a mesh-like metal sheet embedded therein, on the external surface of the external electrode (Paragraph 59).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the electrically conductive assisting member and metallic mesh of Nakamura et al. with the multi-layer piezoelectric device of Murai et al. or Hammer et al.

for the benefit of preventing the occurrence of cracks (Paragraph 59 of Nakamura et al.).

52. With respect to claim 63, the combination of Murai et al. or Hammer et al. and Nakamura et al. discloses the multi-layer piezoelectric element according to claim 62. Nakamura et al. disclose that the electrically conductive adhesive is polyimide resin having electrically conductive particles dispersed therein (Paragraph 59).

53. Claim 61 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al. or Hammer et al. in view of Tsuyoshi et al. (US 6414417).

54. With respect to claim 61, both Murai et al. and Hammer et al. disclose the multi-layer piezoelectric element according to claim 33.

Neither Murai et al. nor Hammer et al. discloses expressly that a groove is formed between the end of the other internal electrode and the external electrode on the first side face, with the groove being filled with an insulating material and a groove is formed between the end of the one internal electrode and the external electrode on the second side face, with the groove being filled with an insulating material, the insulating material having Young's modulus lower than that of the piezoelectric material.

Tsuyoshi et al. teaches a multi-layer piezoelectric device in which a groove (item 21) is formed between the end of the other internal electrode and the external electrode on the first side face (Fig 1b), with the groove being filled with an insulating material (item 21 and column 7, lines 44-49) and a groove is formed between the end of the one internal electrode and the external electrode on the second side face (Fig 1b), with the groove being filled with an insulating material (item 21 and column 7, lines 44-49), the

insulating material having Young's modulus lower than that of the piezoelectric material (column 7, lines 44-59).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the insulating material filled groove of Tsuyoshi et al. with the multi-layer piezoelectric device of Murai et al. or Hammer et al. for the benefit of reducing stress in the piezoelectric layer (column 7, lines 51-59 of Tsuyoshi et al.).

55. Claim 64 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murai et al. or Hammer et al. in view of Nakamura et al. and Kihara et al. (US 2002/0158552).

56. With respect to claim 64, the combination of Murai et al. or Hammer et al. and Nakamura et al. discloses the multi-layer piezoelectric element according to claim 63.

None of Murai et al., Hammer et al., or Nakamura et al. disclose expressly that the electrically conductive particles are silver particles.

Kihara et al. teaches a multi-layer piezoelectric device having an electrically conductive assisting member formed from an electrically conductive resin in which silver particles are dispersed (Paragraph 19).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the silver resin of Kihara et al. with the multi-layer device of Murai et al. or Hammer et al. as modified by Nakamura et al. as silver is a very commonly used conductive material, and for the benefit of using the same material used in the internal and external electrodes.

Allowable Subject Matter

57. Claims 53-57 and 60 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

58. The following is a statement of reasons for the indication of allowable subject matter. The prior art does not disclose or suggest "wherein the proportion of silver contained in electrically conductive material of the internal electrode near the junction with the external electrode is higher than the proportion of silver contained in electrically conductive material of the internal electrode located inside of the stack" in combination with the remaining claim elements of claim 53. The prior art does not disclose or suggest "wherein the internal electrode contains voids and the voids occupy 5 to 70% of the cross sectional area of the internal electrode" in combination with the remaining claim elements of claim 60.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Derek J. Rosenau whose telephone number is (571)272-8932. The examiner can normally be reached on Monday thru Thursday 7:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Darren Schuberg can be reached on 571-272-2044. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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